CLAIMS

1. A liquid container that accommodates liquid used in an imaging apparatus, the liquid container comprising:

a liquid accommodating portion for accommodating the liquid; and

an air flow path for discharging air from the liquid accommodating portion; wherein

the air flow path includes an entrance flow path portion that is connected to the liquid accommodating portion, and a continued flow path portion that continues from the entrance flow path portion; and

the continued flow path portion is arranged to extend in an upper diagonal direction with respect to a reference plane corresponding to a liquid level of the liquid accommodated in the liquid accommodating portion at a standstill state.

2. The liquid container as claimed in claim 1, wherein a length of the entrance flow path portion is arranged such that the liquid does not enter the continued flow path portion when the liquid container is in use and liquid level fluctuation occurs from vibration of the liquid container.

3. The liquid container as claimed in claim 1 or 2, wherein a cross section area of the entrance flow path portion

is greater than a cross section area of the continued flow path portion.

4. The liquid container as claimed in claim 1, wherein a rib is arranged at an opening of the entrance flow path portion that is connected to the liquid accommodating portion.

5. The liquid container as claimed in claim 1, wherein the entrance flow path portion is arranged to extend in a substantially perpendicular direction with respect to the reference plane.

6. A liquid container that accommodates liquid used in an imaging apparatus, the liquid container comprising:

a container main body that forms a liquid accommodating portion for accommodating the liquid;

a flexible film member that is attached to the container main body and is adapted to seal an opening of the liquid accommodating portion; and

an air flow path that is formed at the container main body and is adapted to discharge air from the liquid accommodating portion; wherein

the air flow path includes a flow path portion that does not have a wall formed by the flexible film member.

7. The liquid container as claimed in claim 6, wherein the air flow path includes a trench formed at the container main body, and a through hole that is formed at a wall blocking a portion of the trench.

8. The liquid container as claimed in claim 7, wherein the through hole is formed at a position that is detached from a flow path edge line formed by the trench and the film member.

9. The liquid container as claimed in claim 7 or 8, wherein a length of the through hole is arranged such that the liquid does not pass through the through hole when the liquid container is in use and vibration occurs.

10. The liquid container as claimed in claim 7 or 8, wherein a diameter of the through hole is arranged such that the liquid does not pass through the through hole when the liquid container is in use and vibration occurs.

11. The liquid container as claimed in claim 6, wherein the air flow path includes an accumulation portion that accumulates liquid entering the air flow path.

12. The liquid container as claimed in claim 6, wherein the air flow path includes an entrance flow path portion

that is connected to the liquid accommodating portion, and a continued flow path portion that continues from the entrance flow path portion; and

the continued flow path portion is arranged to extend in an upper diagonal direction with respect to a reference plane corresponding to a liquid level of the liquid accommodated in the liquid accommodating portion at a standstill state.

13. The liquid container as claimed in claim 12, wherein the entrance flow path portion is arranged to extend in a perpendicular direction with respect to the reference plane.

14. The liquid container as claimed in claim 12 or 13, wherein a length of the entrance flow path portion is arranged such that the liquid does not enter the continued flow path portion when the liquid container is in use and liquid level fluctuation occurs from vibration of the liquid container.

15. The liquid container as claimed in claim 12 or 13, wherein a cross section area of the entrance flow path portion is greater than a cross section area of the continued flow path portion.

16. The liquid container as claimed in claim 12 or 13, wherein a rib is arranged at an opening of the entrance flow

path portion that is connected to the liquid accommodating portion.

17. A liquid supply apparatus that supplies liquid to a recording head of an imaging apparatus, the liquid supply apparatus comprising:

a liquid container including a liquid accommodating portion for accommodating the liquid, and an air flow path for discharging air from the liquid accommodating portion; and

a liquid supply unit for supplying liquid to the liquid container; wherein

the air flow path includes an entrance flow path portion that is connected to the liquid accommodating portion, and a continued flow path portion that continues from the entrance flow path portion, the continued flow path portion being arranged to extend in an upper diagonal direction with respect to a reference plane corresponding to a liquid level of the liquid accommodated in the liquid accommodating portion at a standstill state.

18. The liquid supply apparatus as claimed in claim 17, further comprising an atmospheric release unit for opening the air flow path of the liquid container to the atmosphere.

19. A liquid supply apparatus that supplies liquid to a

recording head of an imaging apparatus, the liquid supply apparatus comprising:

a liquid container including a container main body that forms a liquid accommodating portion for accommodating the liquid, a flexible film member that is attached to the container main body and is adapted to seal an opening of the liquid accommodating portion, and an air flow path that is formed at the container main body and is adapted to discharge air from the liquid accommodating portion; and

a liquid supply unit for supplying liquid to the liquid container; wherein

the air flow path includes a flow path portion that does not have a wall formed by the flexible film member.

20. The liquid supply apparatus as claimed in claim 19, further comprising an atmospheric release unit for opening the air flow path of the liquid container to the atmosphere.

21. An imaging apparatus that forms an image by discharging liquid drops from a recording head, the imaging apparatus comprising:

a liquid supply apparatus that includes a liquid container having a liquid accommodating portion for accommodating the liquid, an air flow path for discharging air from the liquid accommodating portion, and a liquid supply unit for supplying

liquid to the liquid container, wherein the air flow path includes an entrance flow path portion that is connected to the liquid accommodating portion, and a continued flow path portion that continues from the entrance flow path portion, the continued flow path portion being arranged to extend in an upper diagonal direction with respect to a reference plane corresponding to a liquid level of the liquid accommodated in the liquid accommodating portion at a standstill state.

22. The imaging apparatus as claimed in claim 21, wherein the liquid container of the liquid supply apparatus is installed in a carriage that implements the recording head.

23. An imaging apparatus that forms an image by discharging liquid drops from a recording head, the imaging apparatus comprising:

a liquid supply apparatus that includes a liquid container having a container main body that forms a liquid accommodating portion for accommodating the liquid, a flexible film member that is attached to the container main body and is adapted to seal an opening of the liquid accommodating portion, and an air flow path that is formed at the container main body and is adapted to discharge air from the liquid accommodating portion; and a liquid supply unit for supplying liquid to the liquid container, wherein the air flow path includes a flow path

portion that does not have a wall formed by the flexible film member.

24. The imaging apparatus as claimed in claim 23, wherein the liquid container of the liquid supply apparatus is installed in a carriage that implements the recording head.

25. A sub tank containing liquid supplied from a main tank and being adapted to supply the liquid to a liquid discharge head that discharges the liquid, the sub tank comprising:

a negative pressure generation unit that includes a flexible film member that is disposed on at least one side of the sub tank, and an elastic member that forces the flexible film member outward with respect to the sub tank, the negative pressure generation unit being adapted to expand and contract in response to the supply and discharge of the liquid, and generate a negative pressure within the sub tank.

26. The sub tank as claimed in claim 25, wherein the flexible film member has a thickness within a range of 10~100 μm.

27. The sub tank as claimed in claim 25 or 26, wherein the flexible film member includes at least two types of films

that are laminated.

28. The sub tank as claimed in claim 27, wherein the flexible film member includes at least a polyethylene film and a nylon film.

29. The sub tank as claimed in claim 26, wherein the flexible film member includes a silica vapor deposition layer.

30. The sub tank as claimed in claim 26, wherein the flexible film member has a protruding portion.

31. The sub tank as claimed in claim 30, wherein the flexible film member is formed by molding a film sheet into a convex shape.

32. The sub tank as claimed in claim 25, wherein the elastic member corresponds to a spring.

33. The sub tank as claimed in claim 25, further comprising a case that includes a negative pressure lever that is arranged to be in contact with an outer side of the flexible film member, the negative pressure lever being displaced in response to a deformation of the flexible film member.

34. The sub tank as claimed in claim 25, further comprising an atmospheric release unit for opening the sub tank to the atmosphere.

35. A liquid supply apparatus comprising:

a sub tank that supplies liquid to a liquid discharge head that discharges the liquid, and a main tank that supplies the liquid to the sub tank, the sub tank including an atmospheric release unit for opening the sub tank to the atmosphere, and a negative pressure generation unit that includes a flexible film member that is disposed on at least one side of the sub tank, and an elastic member that forces the flexible film member outward with respect to the sub tank, the negative pressure generation unit being adapted to expand and contract in response to the supply and discharge of the liquid, and generate a negative pressure within the sub tank,

wherein the liquid is supplied from the main tank to the sub tank, by opening the sub tank to the atmosphere by the atmospheric release unit, and expanding the negative pressure generation unit, after which a negative pressure is generated within the sub tank by closing the atmospheric release unit, discharging a portion of the liquid in the sub tank, and causing the negative pressure generation unit to contract.

36. An imaging apparatus that forms an image by

discharging liquid onto a recording medium from a liquid discharge head, the imaging apparatus comprising:

a sub tank containing liquid supplied from a main tank and being adapted to supply the liquid to the liquid discharge head, the sub tank having a negative pressure generation unit that includes a flexible film member that is disposed on at least one side of the sub tank, and an elastic member that forces the flexible film member outward with respect to the sub tank, the negative pressure generation unit being adapted to expand and contract in response to the supply and discharge of the liquid, and generate a negative pressure within the sub tank.

37. An imaging apparatus that forms an image by discharging liquid onto a recording medium from a liquid discharge head, the imaging apparatus comprising:

a liquid supply apparatus including a sub tank that supplies liquid to the liquid discharge head that discharges the liquid, a main tank that supplies the liquid to the sub tank, the sub tank including an atmospheric release unit for opening the sub tank to the atmosphere, a negative pressure generation unit that includes a flexible film member that is disposed on at least one side of the sub tank, and an elastic member that forces the flexible film member outward with respect to the sub tank, the negative pressure generation unit being adapted to expand and contract in response to the supply

and discharge of the liquid, and generate a negative pressure within the sub tank,

wherein the liquid is supplied from the main tank to the sub tank by opening the sub tank to the atmosphere by the atmospheric release unit, and expanding the negative pressure generation unit, after which a negative pressure is generated within the sub tank by closing the atmospheric release unit, discharging a portion of the liquid in the sub tank, and causing the negative pressure generation unit to contract.

38. An imaging apparatus comprising a liquid discharge head that is adapted to discharge liquid from a nozzle, and a sub tank that is adapted to accommodate liquid supplied from a liquid storage tank and supply the liquid to the liquid discharge head, wherein an amount of liquid that is consumed from the sub tank is detected and a liquid supply operation of supplying liquid to the sub tank is performed according to the detected liquid consumption amount.

39. The imaging apparatus as claimed in claim 38, wherein information pertaining to a liquid discharge amount and an absorption amount is stored beforehand, and the amount of liquid consumed from the sub tank is obtained through calculation of formula (1) that is defined as

liquid consumption amount = Σ (liquid discharge amount $\times$

number of discharges) + Σ(absorption amount × number of absorptions) ···(1).

40. The imaging apparatus as claimed in claim 39, wherein the calculated total sum of the liquid discharge amounts is corrected using a predetermined correction coefficient that is set according to a parameter that reflects a discharge characteristic of the liquid discharge head.

41. The imaging apparatus as claimed in claim 38, wherein information pertaining to a liquid discharge amount for a specific discharge pattern and an absorption amount is stored beforehand, and the amount of ink consumed from the sub tank is obtained through calculation of formula (2) that is defined as

liquid consumption amount = Σ(specific pattern discharge amount × number of specific pattern discharges) + Σ(absorption amount × number of absorptions) ···(2).

42. The imaging apparatus as claimed in 38, wherein the detected liquid consumption amount is compared with a first standard value V1, a second standard value V2, and a third standard value V3 (V1 < V2 < V3); and

when the liquid consumption amount is greater than or equal to the first standard value V1, liquid is supplied to the sub tank right before capping the liquid discharge head;

when the liquid consumption amount is greater than or equal to the second standard value V2, liquid is supplied to the sub tank in between page output operations; and

when the liquid consumption amount is greater than or equal to the third standard value, the sub tank is opened to the atmosphere at least once, after which liquid is supplied to the sub tank and a negative pressure is generated therein.

43. The imaging apparatus as claimed in claim 38, wherein the detected liquid consumption amount is compared with a fourth standard value V4, a fifth standard value V5, and a sixth standard value V6 (V4 < V5 < V6), and

when the liquid consumption amount is greater than or equal to the fourth standard value V4, printing with color ink is disabled after a page output operation;

when the liquid consumption amount is greater than or equal to the fifth standard value V5, printing with black ink is disabled after a page output operation; and

when the liquid consumption amount is greater than or equal to the sixth standard value V6, printing with inks of all colors is disabled during a page output operation.

44. The imaging apparatus as claimed in claim 38, wherein a viscosity of the liquid at 20 ℃ is greater than or equal to 4 mPa/sec.

45. The imaging apparatus as claimed in claim 38, wherein the liquid discharge head corresponds to a head that is adapted to discharge liquid based on a change in a piezoelectric element.

46. A liquid discharge apparatus comprising a liquid discharge head that is adapted to discharge liquid from a nozzle, a sub tank that is adapted to accommodate liquid supplied from a liquid storage tank and supply the liquid to the liquid discharge head, and an open-close unit for switching a state of the sub tank between a sealed state and an opened state, the sub tank including a flexible member and an elastic member for generating a negative pressure, wherein

a nozzle restoration operation is performed in which the sub tank is opened by the open-close unit when an amount of air within the sub tank is greater than or equal to a predetermined amount, and the sub tank is not opened when the amount of air within the sub tank is less than the predetermined amount.

47. A liquid discharge apparatus comprising a liquid discharge head that is adapted to discharge liquid from a nozzle, a sub tank that is adapted to accommodate liquid supplied from a liquid storage tank and supply the liquid to

the liquid discharge head, and an open-close unit for switching a state of the sub tank between a sealed state and an opened state, the sub tank including a flexible member and an elastic member for generating a negative pressure, wherein

a nozzle restoration operation is performed in which the sub tank is opened by the open-close unit when an amount of liquid within the sub tank is less than a predetermined amount, and the sub tank is not opened when the amount of liquid within the sub tank is greater than or equal to the predetermined amount.

48. A liquid discharge apparatus comprising a liquid discharge head that is adapted to discharge liquid from a nozzle, a sub tank that is adapted to accommodate liquid supplied from a liquid storage tank and supply the liquid to the liquid discharge head, and an open-close unit for switching a state of the sub tank between a sealed state and an opened state, the sub tank including a flexible member and an elastic member for generating a negative pressure, wherein

a nozzle restoration operation is performed in which the sub tank is opened by the open-close unit when an amount of air within the sub tank is greater than or equal to a first predetermined amount, or when an amount of liquid within the sub tank is less than a second predetermined amount, and the sub tank is not opened when the amount of air within the sub

tank is less than the first predetermined amount and the amount of liquid within the sub tank is greater than or equal to the second predetermined amount.

49. The liquid discharge apparatus as claimed in any one of claims 46 through 48, wherein

when the sub tank is not opened during the nozzle restoration operation, the nozzle is covered by a cap and liquid at a first absorption amount is absorbed from the nozzle, via the cap, and the sub tank is filled with liquid to a prescribed amount; and

when the sub tank is opened during the nozzle restoration operation, the nozzle is covered by the cap and liquid at a second absorption amount is absorbed from the nozzle via the cap, and the sub tank is filled with liquid to the prescribed amount.

50. The liquid discharge apparatus as claimed in claim 47 or 48, wherein information pertaining to a liquid discharge amount and an absorption amount is stored beforehand, and an amount of liquid within the sub tank is obtained using formula (3) that is defined as

liquid amount in sub tank = full capacity of sub tank - $\{\Sigma$ (discharge amount $\times$ number of discharges) + Σ (absorption amount $\times$ number of absorptions)$\}$ $\cdots$(3).

51. The liquid discharge apparatus as claimed in claim 47 or 48, wherein information pertaining to a liquid discharge amount for a specific discharge pattern and an absorption amount is stored beforehand, and an amount of liquid within the sub tank is obtained using formula (4) that is defined as

liquid amount in sub tank = full capacity of sub tank - {Σ(specific pattern discharge amount × number of specific pattern discharges) + Σ(absorption amount × number of absorptions)} ···(4).

52. The liquid discharge apparatus as claimed in any one of claims 46 through 48, wherein a viscosity of the liquid at 20 ℃ is greater than or equal to 4 mPa/sec.

53. The liquid discharge apparatus as claimed in any one of claims 46 through 48, wherein the liquid discharge head corresponds to a head that is adapted to discharge liquid based on a change in a piezoelectric element.

54. An imaging apparatus comprising a liquid discharge apparatus that includes a liquid discharge head that is adapted to discharge liquid from a nozzle, a sub tank that is adapted to accommodate liquid supplied from a liquid storage tank and supply the liquid to the liquid discharge head, and an open-

close unit for switching a state of the sub tank between a sealed state and an opened state, the sub tank including a flexible member and an elastic member for generating a negative pressure, wherein

a nozzle restoration operation is performed in which the sub tank is opened by the open-close unit when an amount of air within the sub tank is greater than or equal to a predetermined amount, and the sub tank is not opened when the amount of air within the sub tank is less than the predetermined amount.